PHYSICAL HYDROGEOLOGY, 51-365/565 (3 credits)
FALL 2009

INSTRUCTOR: Dr. Maureen Muldoon
Office: Harrington 104
Phone: 424-4461
Email: muldoon@uwosh.edu
Web: http://www.uwosh.edu/faculty_staff/muldoon/

OFFICE HOURS:
Monday: 10:20-12:40
Wednesday: 10:20-12:40
Friday: 10:20-12:40
Or by appointment

CLASS HOURS: 3:00 - 5:10 p.m M W

LOCATION: Harrington 217

REQUIRED TEXTS:

Applied Hydrogeology, C.W. Fetter, 4th edition, Prentice Hall, Inc., 2001. There is a web page containing supplemental information for this book http://www.appliedhydrogeology.info/
A Civil Action, Jonathan Harr, 1995, Vintage Books (paperback)

SUPPLEMENTAL TEXTS:

Basic Ground-Water Hydrology, Ralph Heath, 1980, U.S. Geological Survey, Water-Supply Paper 2200
Fundamentals of Ground Water, F.W. Schwartz and H. Zhang, John Wiley & Sons, 2003

COURSE WEB PAGE:

I have developed a D2L site for this course. You must login to the D2L system using the same username an password that you use to access your UW-Oshkosh email account. Within the Physical Hydrogeology course, there is a navigation bar above the announcement area that contains the following tabs: Course Home, Content, Dropbox, Links, Grades, and Schedule. For each chapter, I will post a lecture outline and PowerPoint in the CONTENT area.

ABOUT THIS COURSE:

What do we study?

The purpose of this course is to develop a sound understanding of the various aspects of the hydrologic cycle, with the major emphasis on groundwater hydrology. The first third of the course provides an overview of the hydrologic cycle, surface water hydrology, and water budgets. The second two-thirds of the course emphasizes aquifers properties, principles of groundwater flow, flow in the unsaturated zone, well hydraulics and regional groundwater flow systems. In addition to covering the above topics; this course is designed to give you experience in manipulating, analyzing and presenting hydrogeologic data.

Course Goals

At the end of this course you should be able to
•use real-world data to develop a water budget for a basin;
•evaluate the porosity, permeability, and hydraulic characteristics of various geologic materials;
•construct water-table maps and hydrogeologic cross sections from subsurface data;
•predict groundwater flow patterns based on hydraulic head distribution and be able to predict how heterogeneities will affect groundwater flow patterns;
•analyze aquifer test data; and
•answer a new hydrogeologic problem by identifying what data to collect, which analytical method to use, and be able to communicate your results.

Prerequisites:

The study of groundwater differs from some other areas of geology in that we can rarely observe groundwater or the processes that control groundwater flow. Therefore, we must use the principles of physics (and chemistry) to describe and predict the behavior of groundwater. This means that the course will be quantitative in nature. College Algebra and Trigonometry (67-108) are a prerequisite for this

course and I will assume that everyone is comfortable with problem-solving involving algebra, unit conversions, graphing, and calculators.

EXPECTATIONS:

What I expect from you:

- to take responsibility for your own learning
- to come prepared for class and be an enthusiastic participant in class
- to set high standards for work in group settings and in individual assignments
- to behave in an ethical manner

What you can expect from me:

- to be enthusiastic and knowledgeable about the course material
- to create a challenging course
- to treat you with fairness and respect
- to set high standard for the class

Attendance and Participation:

In order for you to get the most out of this class, it is crucial that you attend each class session and that you have completed the reading assignment *prior* to class. The required reading assignments are listed in the following course schedule. To help focus your reading, I will post "reading review questions" for each topic on the D2L site. You should prepare written answers to these questions *before* coming to class.

Assignments:

The assignments (in-class exercises, problem sets and labs) are critical to helping you gain an understanding of the material covered. The labs are designed to reinforce the material covered in lecture as well as give you "hands-on" experience in manipulating and interpreting hydrologic data. The problem sets will provide you with practice in solving quantitative problems. All problem sets and labs are due on the specified due date. Late assignments will not be accepted unless there are extenuating circumstance and prior arrangements have been made.

EVALUATION:

Exams: There will be three hour exams. If you need to miss a scheduled exam (for some valid reason such as illness), you must inform me prior to the exam (by phone or email). A make-up exam must be taken as soon as possible at a time convenient for us both.

Laboratory: A report will be due for each lab exercise. The level of report will vary from exercises turned in at the end of class, short written reports, and some lab exercises will require that you work in groups and present your results to the rest of the class in a brief presentation. The due date for each lab will be announced when the lab is given out.

Problems: Several problem sets will be assigned during the semester on an approximately weekly basis. Solutions (including all work and assumptions) must be written neatly. Problem sets can be turned in during class or placed in my mailbox by 6:00 pm on the due date. Any assignment submitted after that time will be considered late, unless arrangements have been made for an excused late submittal. Late work will be penalized 10% for each day that it is late.

Outside Reading:

Over the course of the semester, you are expected to read Jonathan Harr's *A Civil Action,* a well-written account of an actual groundwater contamination case in Woburn, MA. Several of your lab exercises will be based on data from the Woburn area. You should keep a "journal" while reading the book. As you read, note the pages where you come across information that

you feel will be pertinent in the groundwater contamination case. This will serve to focus your reading and help you develop an index to the places in the book that contain pertinent hydrogeologic data.

SPECIAL NEEDS: Any students who needs special accommodations for learning or who have special needs are invited to share these concerns or requests with the instructor as soon as possible.

ACADEMIC HONESTY

It is acceptable to work together on lab write-ups and problem assignments, however, it is not acceptable to copy a fellow student's work. Each student will be responsible for the material covered in the assignments and must be able to present his/her work. Violations will result in a score of zero on the assignment and will be reported to the Dean of Students for further disciplinary action. See the *University of Wisconsin Oshkosh Student Discipline Code* http://www.tts.uwosh.edu/dean/studentdisciplinecode.html for definitions of academic misconduct and details about procedures, sanctions, and other relevant information.

Grades:

15%	Exam 1
15%	Exam 2
15%	Exam 3
25%	Labs
20%	Problem sets
10%	Class Participation

Scale

93 - 100%	A	73 - 77%	C
90 - 93%	A-	70 - 73%	C-
87 - 90%	B+	67 - 70%	D+
83 -87%	B	63 - 67%	D
80 - 83%	B-	60 - 63%	D-
77 - 80%	C+	<60%	F

The final letter grade will be assigned based on the above scale, unless the class average deviates significantly from 75%. In the latter case, a "curve" will be applied.

TENTATIVE COURSE SCHEDULE:

This schedule may change slightly. The SCHEDULE tab in the D2L site contains detailed reading assignments for each day and will reflect any changes in the course schedule.

Week		Topic	Reading
1	9/9	Intro/What is Hydrogeology **Lab:** Quantitative Problems	1.1-1.2, 1.6-1.8 (skim)
2	9/14	Water/Water Budgets **Lab:** Measurements	1.3 - 1.5 1.11-1.12
	9/16	Darcy's Law & Hydraulic Head **Lab:** Sank Tank Model	3.4.1, 4.1-4.4
3	9/21	Force Potential & Darcy's Law **Lab:** Permeability	4.5-4.6
	9/23	Mapping Hydraulic Head/Gradients **Lab:** Field Measurement of Head	3.6, 3.8, 3.12
4	9/28	Porosity/Specific Yield **Lab:** ~~Porosity/Grain-size~~ Preparation for Field Day	3.1-3.3
	9/30	Sampling wells on land UWO is looking to purchase	
5	10/5	Geologic Controls on Porosity/ Permeability **Lab:** Review	S&Z pg 13-32
	10/7	**EXAM 1** – chapters 1, 2, & part 3	

6	10/12	Hydraulic Conductivity/Heterogeneity **Lab:** Woburn Introduction	3.4-3.5, 3.11
	10/14	Aquifers/Aquifer Characteristics (T, S) **Lab:** Basin Delineation/Water Resources Report	3.7, 3.9-3.10
7	10/19	*No Class (GSA in Portland)*	
	10/21	Evaporation/Transpiration **Lab:** Woburn ET Calculation	2.1-2.3
8	10/26	Precipitation/Infiltration/Soil Moisture **Lab:** Woburn Climatic Data	2.4 - 2.8 1.9-1.10
	10/28	Stream flow and Stream/GW interaction Analysis of Streamflow Data	2.9 - 2.10, 2.13 2.11-2.12, 2.14
9	11/2	**Lab:** Stream Data Analysis, Woburn	
	11/4	**Lab:** Woburn Water Budget Report Regional GW Flow -topographic driving force	7.1-7.3
10	11/9	GW/SW Interaction **Lab:** TopoFlow exercise1	7.5-7.7
	11/11	Granular vs. Fractured Media **Lab:** Woburn Cross Section	D&S pg 48-51
11	11/16	**Exam 2**	4.7
	11/18	Derivation GW Flow Equations **Lab:** Woburn Water Table	4.9 - 4.12
12	11/23	Solutions to GW Flow Equations **Lab:** Flow Nets	4.8, 4.13-4.14
	11/25	Thanksgiving Break – No Class	
13	11/30	Aquifer Tests— response of an ideal well to pumping **Lab:** Aquifer Test Analysis	5.1-5.5
	12/2	Single-well tests Aquifer Tests --non-ideal wells **Lab:** Aquifer Test Analysis	5.6-5.7 5.8-5.9
14	12/7	Unsaturated Zone Flow **Lab:** Civil Action Discussion	6.1-6.7
	12/9	Managing GW Resources **Lab:** WI – Water Rich, Water Poor	11.1-11.5
15	12/14	**Catch up/Review**	
	12/16	**Exam 3**	